

BAT-INFESTING *ORNITHODOROS* (IXODOIDEA-ARGASIDAE) OF THE  
ORIENTAL-AUSTRALIAN REGION.

By L. J. DUMBLETON, Entomology Division, Department of Scientific and  
Industrial Research, New Zealand.

(Communicated by Dr. J. W. Evans.)

(Eighteen Text-figures.)

[Read 26th November, 1958.]

*Synopsis.*

Confirmatory evidence based on the reticulated structure of Haller's organ in the larvae supports Hoogstraal's recognition, on adult characters, of a group of bat-infesting tick species within the genus *Ornithodoros*. The genus *Reticulinasus* Schulze is reduced to rank as a subgenus of *Ornithodoros*. Another member of the subgenus, *O. solomonis*, is described from the Solomon Islands.

Hoogstraal (1953) has drawn attention to a group of Oriental bat-infesting *Ornithodoros* which are characterized in the adult stage by small size, pyriform shape, small inconspicuous discs, mammillated integument and absence of eyes, cheeks, dorsal hood and dorso-central tarsal humps. The species included are *O. salahi* Hoogstraal, 1953, *O. batuensis* Hirst, 1929, and possibly *O. piriformis* Warburton, 1918, which, however, has distinct discs. Kohls (in litt.) considers that the Philippine species mentioned by Hoogstraal is identical with *batuensis*.

The only other Oriental-Australian bat-infesting species known to me are *Argas steini* Schulze, 1935, which for reasons given below is considered to be an *Ornithodoros*, and another species from the Solomon Islands which is described below. Both of these are known only in the larval stage.

In studying the Solomons larva it was found that Haller's organ possessed the characteristic reticulated structure of the capsule which Schulze (1941) described in *A. steini*, for which he erected the genus *Reticulinasus*. The larvae of *O. salahi* and the presumed larva of *O. batuensis* have similarly reticulated capsules. The larvae of *O. piriformis* are not known.

Hoogstraal's grouping indicated on adult characters is therefore confirmed by the characters of Haller's organ in the larvae. Schulze's genus *Reticulinasus* is reduced to rank as a subgenus of *Ornithodoros*.

CHAETOTAXY OF TARSUS I IN ARGASID LARVAE. (Text-figs. 1-5).

In the species of *Argas* and *Ornithodoros* studied the following setae are constant in occurrence:

All ventral setae, viz., apical ventral (AV) 1 pair; basal ventral (BV) 1 pair; mid-ventral (MV) 1 pair. In *Argas* spp. (Text-figs. 4, 5) these latter are basad of the capsule whereas in *Ornithodoros* they are level with or basad of the trough.

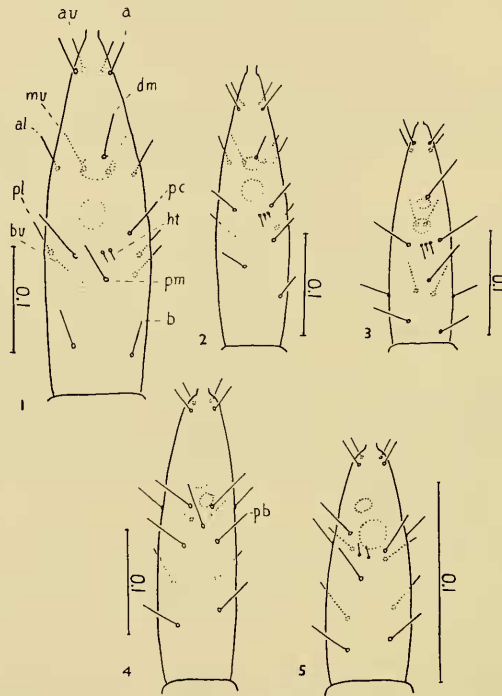
Three pairs and 1 single dorsal seta, viz., apical (A) 1 pair; basal (B) 1 pair; paramedian capsular (PC) 1 pair—level with or basad of the capsule; posterior median (PM)—a single seta basad of and forming a triangle with PC.

There is more variation in the occurrence and position of the lateral setae and the remaining dorsal setae. The lateral setae comprise anterior (AL) 1 pair—the only lateral setae present in *salahi* and *batuensis* (Text-fig. 2) and the two species of *Argas* (Text-figs. 4, 5) but absent in *O. capensis* (Text-fig. 3); posterior (PL) 1 pair—basad of the capsule or posterior hair tuft, the only lateral setae in *capensis* and in *solomonis* occurring in addition to AL.

The remaining dorsal setae are: distal median (DM) — a single seta distad of trough on the subapical tarsal prominence in four *Ornithodoros* spp. but absent in two *Argas* spp.; posterior hair tuft (HT) — shorter setae with the bases membranous or in a membranous area and close together, situated between PC — absent in *A. persicus*, 2 in *A. vespertilionis* and *O. solomonis*, 3 in *O. batuensis*, *salahi* and *capensis*; pre-basal (PB) 1 pair — present in *A. persicus* only.

HALLER'S ORGAN IN ARGASID LARVAE. (Text-figs. 1-5, 10, 11, 14, 18.)

The anterior trough or pit and the capsule may be considered as constituting Haller's organ in a narrow sense but the following setae are in close and constant relation to it: DM, PC, PM, HT. The anterior trough or pit is a membranous circular or oval area posterad of the subapical prominence bearing up to eight conical or



Text-figs. 1-5.—Larva, tarsus I, chaetotaxy, dorsal of 1, *O. solomonis*; 2, *O. batuensis*; 3, *O. capensis*; 4, *A. persicus*; 5, *A. vespertilionis*.

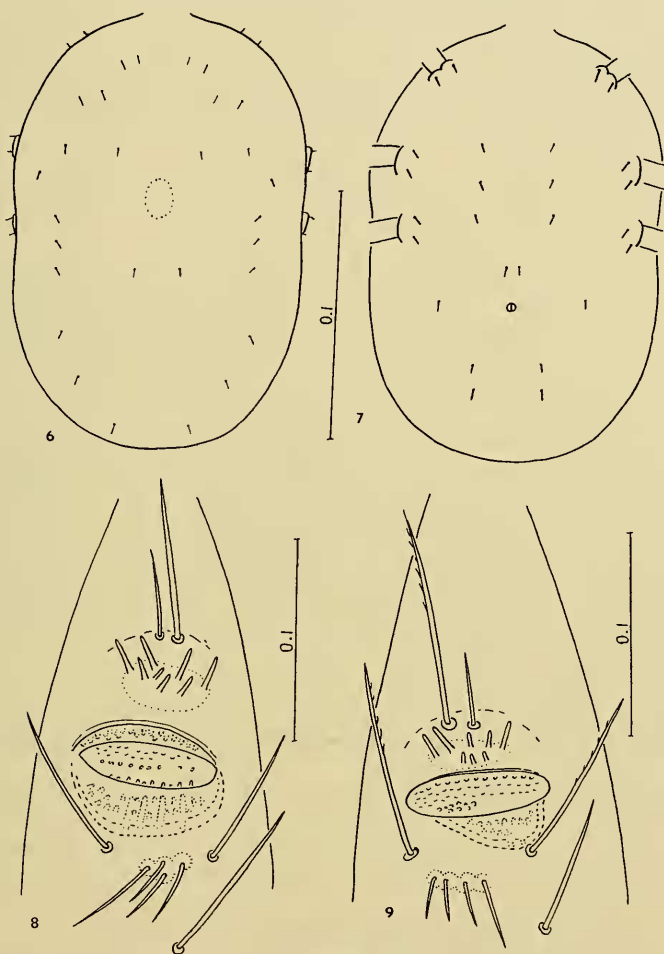
finger-like setae or sense cones. In the species studied it shows no obvious diagnostic characters. The capsule is posterad of the trough. It consists of a subspherical pocket or cavity, with heavily chitinized walls and floor, invaginated into the tarsus and roofed with a thinly chitinized or membranous cover with a transverse oval orifice anteriorly. Three or four modified finger-like setae arise from the wall of the capsule basad. They are often difficult to distinguish and do not appear to offer diagnostic characters. The capsule varies in shape from circular to transverse or asymmetrical, from shallow to deep and narrow-necked and in position from a simple vertical-walled invagination to an obliquely basad invagination, and these variations offer good specific characters. In the subgenus *Reticulinasus* of *Ornithodoros* the walls and floor of the capsule bear regular and strong reticulations, the roof or cover also has the reticulations well developed marginally but they become indistinct as they approach the orifice of the capsule.

Bat-infesting species are more numerous in North and South America, but none of their larvae are so far reported as having a reticulated capsule. Schulze (1941)

states that it was not present in *O. hasei* Schulze (? *O. dunni* Matheson). *Reticulinasus* may prove to be a subgenus restricted to the Oriental-Australian regions. The reticulated capsule is not reported from the genus *Argas* and is not present in larvae of *A. persicus* and *A. vespertilionis* which I have examined.

BODY CHAETOTAXY IN ORNITHODOROS LARVAE. (Text-figs. 6, 7.)

The following number and arrangement of setae is constant in the subgenus *Reticulinasus*. Dorsal setae consist of 14 pairs: 4 pairs anterior—2 submedian and 2 sublateral; 2 pairs forming a transverse row before mid-length; 3 pairs sublateral;



Text-figs. 6-9.

6, 7.—Larva, body chaetotaxy of *O. solomonis*. 6, dorsal; 7, ventral.

8, 9.—Adult, Haller's organ, dorsal of 8, *O. batuensis*; 9, *O. sahai*.

2 pairs forming a transverse row behind mid-length; 3 pairs posterior sublateral or marginal. The ventral setae consist of 13 pairs; 1 pair on each coxa; 3 pairs paramedian between coxae II and coxae III; 1 pair paramedian preanal close together; 1 pair paraanal; 2 pairs paramedian postanal.

Other species of *Ornithodoros*, for example *capensis* and the species figured by Cooley and Kohls (1944), show variation in the number of pairs of dorsal setae between 7 (*turicata*) and 18 (*coriaceus*) and *capensis* has more numerous ventral setae, especially in the postanal field.

## TARSAL CHARACTERS IN ORNITHODOROS ADULTS. (Text-figures 8, 9.)

The adults of only two species, *salahi* and *batuensis*, of the subgenus *Reticulinasus* are correlated with the larvae. The adults of both differ from *talaje* and *capensis* in the more numerous lateral setae on the sides of tarsus I. The depression of the roof of the capsule below the level of both the trough and the posterior hair tuft, which is common to both *salahi* and *batuensis*, may be a group character. Haller's organ is similar in *batuensis* (Text-fig. 8) and *salahi* (Text-fig. 9) — four setae in the posterior hair tuft, trough with eight sense cones, distal median setae two unequal. The capsule of these two species does not differ markedly, except in shape, from other *Ornithodoros* species.

The differences between the two species are that in *salahi* (Text-fig. 9) the tarsal setae are more noticeably plumose and the capsule is asymmetrically invaginated basad while in *batuensis* (Text-fig. 8) the capsule is invaginated vertically.

The occurrence may be mentioned here of modified ventral setae on tarsus I of adults of *O. gurneyi* Warburton.

DESCRIPTIONS AND NOTES ON ORNITHODORUS LARVAE OF THE SUBGENUS  
RETICULINASUS (Schulze, 1941).

## ORNITHODOROS SOLOMONIS, n. sp. (Text-figs. 1, 6, 7, 10, 11-13.)

*Larva* (engorged).—Length, including capitulum 1.9–2.2 mm., width 1.1–1.2 mm. Colour (in life) slaty-grey. Shape elongate with slight constriction at level of coxae II and stronger constriction immediately caudad of coxae III. Integument finely striate except for smooth oval median area at mid-length on dorsum. Body chaetotaxy (Text-figs. 6, 7) identical with that of other members of the group. The posterior dorsal setae are submarginal though the median pair may reach the margin. These setae, although the larva is larger, are shorter than those of *salahi* and *batuensis*. Leg length 1.16 mm. Tarsus I total length including claw 0.48 mm., to base of claw 0.34 mm. Tarsal setae (Text-fig. 1) 18 pairs plus 2 setae in posterior hair tuft. Distal median seta (DM) apparently inserted on trough. Two pairs of lateral setae AL and PL. Haller's organ (Text-fig. 10) with capsule (Text-fig. 11) elongate, ovoid, with floor walls and periphery of roof reticulated. Basis capituli with 2 paramedian post-hypostomal setae and 2 longer post-palpal setae. Hypostome (Text-fig. 12) length 0.18 mm., dentition 2/2 with 8 teeth in outer file and 8 rounded teeth in inner file. Palpi with joints 2 and 3 longer than wide, apical joint twice as long as wide, sides subparallel, apical setae not half as long as joint.

*Type*.—Larva on slide mount in author's collection. *Paratypes*: 15 larvae on slide mounts in author's collection. *Other material*: 10 larvae in Rocky Mountain Laboratory collection.

*Type Locality*.—Gill's Plantation, Joroveto, Vella Lavella Island, Solomon Islands. Coll. L.J.D.

*Host*.—Fruit bat ex cave. Larval ticks standing on head in caudal region of dorsum, one inch from tail. Larvae of the Trombiculid mite *Whartonia vellae* (Dumb.) also present.

*O. solomonis* may be separated from related species as follows:

- |  |                              |
|--|------------------------------|
| (1) Palpal joint 4 twice as long as wide. Strong posterior marginal setae absent. Posterior hair tuft with 2 setae ..... | <i>O. solomonis</i> , n. sp. |
| Palpal joint 4 little longer than wide. Strong posterior marginal setae present. Posterior hair tuft with 3 setae .....  | (2).                         |
| (2) Capsule of Haller's organ elongate, pyriform .....   | <i>O. batuensis</i> Hirst.   |
| Capsule of Haller's organ subcircular .....  | <i>O. salahi</i> Hoogstraal. |
- (*O. steini* Schulze is inadequately described but would apparently fall in couplet 2.)

## ORNITHODOROS BATUENSIS Hirst. (Text-figs. 2, 14-17.)

*Larva* (presumed) (engorged).—Length 1.0 mm., width 0.7 mm. Body chaetotaxy conforms to that of the group. Tarsus I (Text-fig. 2) length to base of claw 0.2 mm., chaetotaxy identical with that of *salahi*. Strong posterior marginal setae as in *salahi*. Hypostome (Text-fig. 16) length 0.08 mm., dentition 2/2 with 6–7 teeth in outer file and 6 in inner file. Haller's organ (Text-fig. 14) with capsule (Text-fig. 15) elongate,

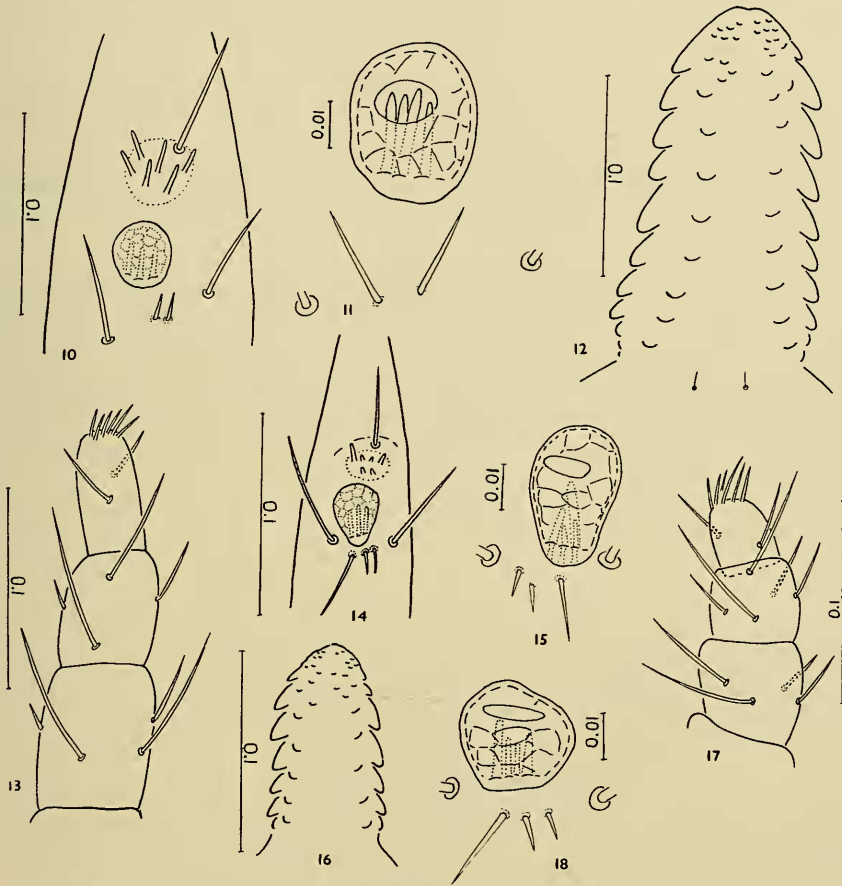


pyriform, narrower basally. Palpi (Text-fig. 17) with joints 2 and 3 subquadrate, as wide or wider than long; apical joint tapering, little longer than wide, apical setae nearly as long as joint.

The specimens examined were collected 28/7/55 by J. L. Harrison from Batu Caves (type locality), Malaya, from the bat *Eonycteris spelaea*.

ORNITHODOROS SALAHI Hoogstraal. (Text-fig. 18.)

Larva elongate. Hypostome length 0.12 mm., dentition 2/2 with 8 teeth in outer file and 4-5 in inner file. Tarsus I 0.23 mm. long to base of claw. Haller's organ has



Text-figs. 10-18.

10-13.—*O. solomonis* larva. 10, 11, Haller's organ, dorsal; 12, hypostome; 13, palp.

14-17.—*O. batuensis* larva. 14, Haller's organ, dorsal; 15, capsule, dorsal; 16, hypostome; 17, palp.

18.—*O. salahi*, larva capsule, dorsal.

a slightly transverse subcircular reticulated capsule. Posterior marginal body setae are present and strong, and the dorsal and ventral body chaetotaxy corresponds to that of *solomonis* and *batuensis*. There are 16 setae on tarsus I as in *batuensis*. There are 3 setae in the posterior hair tuft. The proportions of the palpal joints are similar to those of *batuensis*.

ORNITHODOROS STEINI (Schulze).

Only the larva, described from fruit bats from Timor, is known. The shape was given as elongate and anteriorly truncate. The dentition is 2/2 with 7 teeth in the outer file. Schulze's (1941, fig. 36a) figure shows strong posterior marginal setae and

relatively short palpal joints. The capsule of Haller's organ is described as subcircular and reticulate. It is stated that there are five setae in the posterior hair tuft. If this includes what I have called the paramedian capsulars (PC) then it is similar to *salahi* and *batuensis* and differs from *solomonis*. If there are five setae present in the tuft the species is distinct from the other three.

Schulze considered that larvae from *Nycteris javanica* in West Java were identical with *steini* in that they had a similarly reticulated capsule but they could well be another species.

The species is transferred to *Ornithodoros* because the reticulated capsule of Haller's organ is known in several species of that genus but is not known in *Argas*.

The type is reputed to be in the Berlin Museum but I have been unable to see it or to have comparisons made.

#### Acknowledgements.

I am much indebted to the following: Dr. H. Hoogstraal, of Cairo, for larvae of *O. salahi* and *A. vespertilionis* and adults of *O. batuensis*; Dr. J. L. Harrison, of Kuala Lumpur, for larvae of *O. batuensis*; Dr. F. H. S. Roberts, of Brisbane, for larvae of *A. persicus* and adults of *O. gurneyi*; and Dr. G. M. Kohls, of the Rocky Mountain Laboratory, for photostats of literature.

#### References.

- COOLEY, R. A., and KOHLS, G. M., 1944.—The Argasidae of North America, Central America and Cuba. *Amer. Midland Naturalist*, Monograph No. 1, Univ. Press, Notre Dame, Indiana, 152 pp.
- HOOGSTRAAL, H., 1953.—*Ornithodoros salahi*, sp. nov. (Ixodoidea, Argasidae) from Cairo Citadel, with notes on *O. piriformis* Warburton 1918 and *O. batuensis* Hirst 1929. *Jour. Parasitology*, 39, 3: 1-8.
- SCHULZE, P., 1935.—Zur Vergleichenden Anatomie der Zecken. *Zeits. Morph. Okol. Tiere*, 30, 1: 1-40.
- , 1941.—Das Geruchsorgan der Zecken. *l.c.*, 37: 491-564.
-